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The Compatibility of Candidate Navy Decontaminating Solutions with Alkyd and Non-Skid Painted Surfaces

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13. ABSTRACT (Maximum 200 words) This report describes a study to determine the effect of seawater solutions of calcium hypochlorite, lithium hypochlorite and sodium dichloroisocyanurate on non-skid and alkyd-painted surfaces at room temperature. The effect of oxidizer concentration, solution pH, and submersion time were evaluated. Weight gain measurements and visual inspection were used to determine the coatings' compatibility with the detoxifiers.				
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THE COMPATIBILITY OF CANDIDATE NAVY DECONTAMINATING SOLUTIONS WITH ALKYD AND NON-SKID PAINTED SURFACES

I. INTRODUCTION

The Naval Research Laboratory (NRL) is currently engaged in developing a new decontaminating solution to be used aboard Navy ships. The current detoxifier, calcium hypochlorite (HTH), is highly corrosive and is also hazardous from a fire standpoint. NRL has proposed replacing HTH with an alternate detoxifier such as sodium dichloroisocyanurate (SD) or lithium hypochlorite (LiOCl). While both detoxifiers are less flammable and more stable than HTH, it remains to be shown that the proposed alternate detoxifiers are less detrimental to shipboard materials.

The effect of the proposed detoxifiers in comparison to the current standard on a range of untreated Navy metals has been discussed in detail in previous reports [1,2]. Navy ships, however, have very little unpainted metal surfaces due to their hostile sea-air environment. Most metal surfaces and equipment aboard ship are coated with a corrosion-resistant alkyd paint. Decks exposed to weather are often coated with a polymer foundation non-skid epoxy. Since the areas aboard ship most likely to be decontaminated in the event of a chemical warfare attack include both decks and equipment, the effect of the detoxifiers on these exposed coatings needs to be determined.

This report investigates the effect of calcium hypochlorite, lithium hypochlorite and sodium dichloroisocyanurate solutions on aged and freshly painted non-skid and alkyd surfaces in seawater at room temperature. The effect of oxidizer concentration, solution pH, and submersion time were evaluated. Weight gain measurements and visual inspection were used to estimate the coatings' compatibility with the detoxifiers.

II. EXPERIMENTAL

Materials/Solutions

Samples of stainless steel approximately 1/2" x 3" X 1/16" covered on one side only with non-skid deck coating (Mil Spec D-23003) and samples coated on one side only with safety yellow, mobile deck gear coating (Mil Spec DOD-E-698) were prepared approximately four years ago for use in a previous study. The

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The test sample was weighed on a Mettler AE 163 balance, and placed in the test tube containing the oxidizing solution. The test tube was covered loosely with plastic and the solution was allowed to react with the sample for the appropriate time. Following testing, the sample was removed from the test tube, dipped in warm laboratory surfactant, rinsed with distilled water, and air-dried thoroughly. Finally, the sample was reweighed and retained for visual analysis.

III. RESULTS/DISCUSSION:

Non-Skid Surfaces:

Table 1 gives the measured weight changes for the non-skid samples submerged under lithium hypochlorite, sodium dichloroisocyanurate, and calcium hypochlorite. The significance of the data is limited since measured weight gains were fairly scattered across the design matrix. This scatter is most likely due to the non-uniformity and porosity of the non-skid surfaces. The only obvious trend apparent from the weight measurements was the effect of solution pH. Acidic solutions produced much higher weight gains than basic solutions for the LiOCl and HTH solutions.

Visual inspection, however, was much more enlightening than the weight changes. Non-skid coated samples had two separate applications of the coating as described in the materials section. For analysis purposes, the side of the sample with the aged application of the non-skid coating will be referred to as Side 1 while the side with the fresh application will be referred to as Side 2.

Following experimentation, the samples were lined up in terms of the most faded to the least faded and ranked. A control specimen was used for reference purposes. Samples were lined up and ranked a second time in terms of the most pitted to the least pitted. The samples were then given a value from 1 to 4 representing the degree that the sample was affected by the oxidizing solution. The values correspond to the following visual observations for the non-skid samples:

- 0: No obvious changes
- 1: Very slightly affected, slight fading, no pitting
- 2: Slightly affected, slight fading, slight pitting
- 3: Affected, general fading and pitting
- 4: Greatly affected, greatly faded and pitted

Results of the tests can be found in Figures 1-3.

In all cases, Side 2 (or the freshly painted side) seemed to be affected by the detoxifiers more than Side 1. Side 1 contained no obvious pitting in all cases, while Side 2 often contained pitting. Therefore, any notation of pitting always

occurred on Side 2. This indicates a difference in the two applications of the non-skid paint. In no case was the coating removed from the metal.

The results show that in most cases, SD caused the least amount of changes to the non-skid surfaces of the three detoxifiers studied. With one exception, samples submerged in SD solutions showed only slight fading and no pitting. The exception to this statement occurred for very acidic solutions. Submersion in these solutions produced a slight amount of pitting as well. Neither the percent of SD in the solution nor the submersion time showed any obvious effects on these samples.

The LiOCl solutions exhibited a greater effect on the non-skid samples. While the one hour sample showed only slight fading, the eight hour sample was greatly affected and pitted relative to the other samples. Likewise, acidic solutions of LiOCl greatly faded and pitted the non-skid surface while basic solutions were slightly less detrimental and exhibited a general amount of fading and pitting. Neutral solutions containing dilute LiOCl concentrations only showed some fading and no pitting.

With the exception of the one hour sample, HTH solutions greatly altered the surface of the non-skid coating. Samples showed both a great deal of fading and pitting regardless of the conditions.

While SD appears to affect the non-skid coatings the least, live agent test results [4] indicate that SD decontaminating solutions removed more live agent from non-skid and alkyd surfaces than either HTH or LiOCl. This suggests that SD solutions are capable of penetrating these surfaces with less adverse effects and more efficiency than either LiOCl or the current standard, HTH.

Alkyd Surfaces

Measured weight gains for the alkyd-painted samples are listed in Table 2. While the scatter of the data for the non-skid samples made the data somewhat difficult to analyze, weight changes for the alkyd-painted samples showed more obvious trends. For all three detoxifiers, the increased submersion time from one hour to eight hours showed an increased weight gain. For the HTH and LiOCl samples, acidic solutions exhibited very high weight gains relative to those measured for basic solutions. The acidic SD solutions, however, showed only a slight increase in weight. The percent of detoxifier had an insignificant effect with the exception of the LiOCl solutions where high concentrations produced much higher weight changes than those of lower concentrations.

Visual inspection of the alkyd samples following experimentation showed no difference between the effect of the

oxidizers on the aged yellow gear and the freshly painted grey alkyd paint. Figures 4-6 give the results of the visual inspection. The samples were given a numerical value from 0 to 4 representing the degree to which the samples were affected by the oxidizers. Since the visual effect of the oxidizers on the alkyd samples differed from the non-skid samples, the numerical values used for the alkyd samples represent a different set of observation criteria. The values used for the alkyd samples correspond to the following visual observations:

- 0: No obvious changes
- 1: Slight color changes
- 2: Slight blistering
- 3: Color transformations
- 4: Severe blistering

Note that for the bar graphs in Figures 4-6, a value less than 1 represents no obvious changes.

Visually, oxidizer concentration had an insignificant effect on the painted surfaces. Concentrated solutions of LiOCl , however, caused the coupon to blister slightly. These observations followed the weight measurements trends. Additionally, the effect of submersion time was insignificant for all three oxidizers.

The visual effects of solution pH on the samples were also similar to those noted from the weight measurements. With the exception of LiOCl , basic solutions of detoxifiers did not appear to affect the coupons. Basic solutions of LiOCl showed a uniform discoloration of the yellow gear paint to a dark tannish color. Acidic solutions of HTH and LiOCl , however, blistered the painted surfaces completely. Acidic solutions of SD did not blister the panel, but produced a slight non-uniform discoloration of the yellow gear paint to tan.

IV. CONCLUSIONS:

The following conclusions can be made from this study:

1. Basic solutions of calcium hypochlorite and lithium hypochlorite are preferable to acidic solutions for compatibility with non-skid and alkyd painted surfaces.
2. Of the three detoxifiers considered in this study, solutions of sodium dichloroisocyanurate produced the least change to both non-skid and alkyd painted surfaces.
3. For the non-skid surfaces, freshly painted samples seemed more susceptible to the oxidizing solutions than aged samples.

V. RECOMMENDATIONS:

Based on these compatibility tests, Sodium Dichloroisocyanurate should be considered a viable and less corrosive alternative to HTH as a decontaminating solution component.

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TABLE 1: Measured Weight Gain for Non-Skid Samples Submerged Under Navy Decontaminating Seawater Solutions

Variable			% Weight Gain		
<u>% Oxidant</u>	<u>pH</u>	<u>Time (hrs)</u>	<u>HTH</u>	<u>LiOCl</u>	<u>SD</u>
2.75	7.5	1.0	0.0651	0.0998	0.1439
2.75	4.0	4.5	0.4789	0.4463	0.1142
2.75	11.0	4.5	0.0431	0.1810	0.0963
2.75	7.5	8.0	0.1152	0.1788	0.0261
0.50	7.5	4.5	0.0672	0.1295	0.1246
5.00	7.5	4.5	0.0046	0.1335	0.1699

TABLE 2: Measured Weight Gain for Alkyd Samples Submerged Under Navy Decontaminating Seawater Solutions

Variable			% Weight Gain		
<u>Percent Oxidant</u>	<u>pH</u>	<u>Time (hrs)</u>	<u>HTH</u>	<u>LiOCl</u>	<u>SD</u>
2.75	7.5	1.0	0.0106	0.0151	0.0090
2.75	4.0	4.5	0.4441	0.3800	0.0470
2.75	11.0	4.5	0.0090	0.0295	0
2.75	7.5	8.0	0.0200	0.0301	0.0160
0.50	7.5	4.5	0.0083	0.0093	0.0073
5.00	7.5	4.5	0.0093	0.0497	0.0124

FIGURE 1: EFFECT OF pH ON NON-SKID
VISUAL INSPECTION

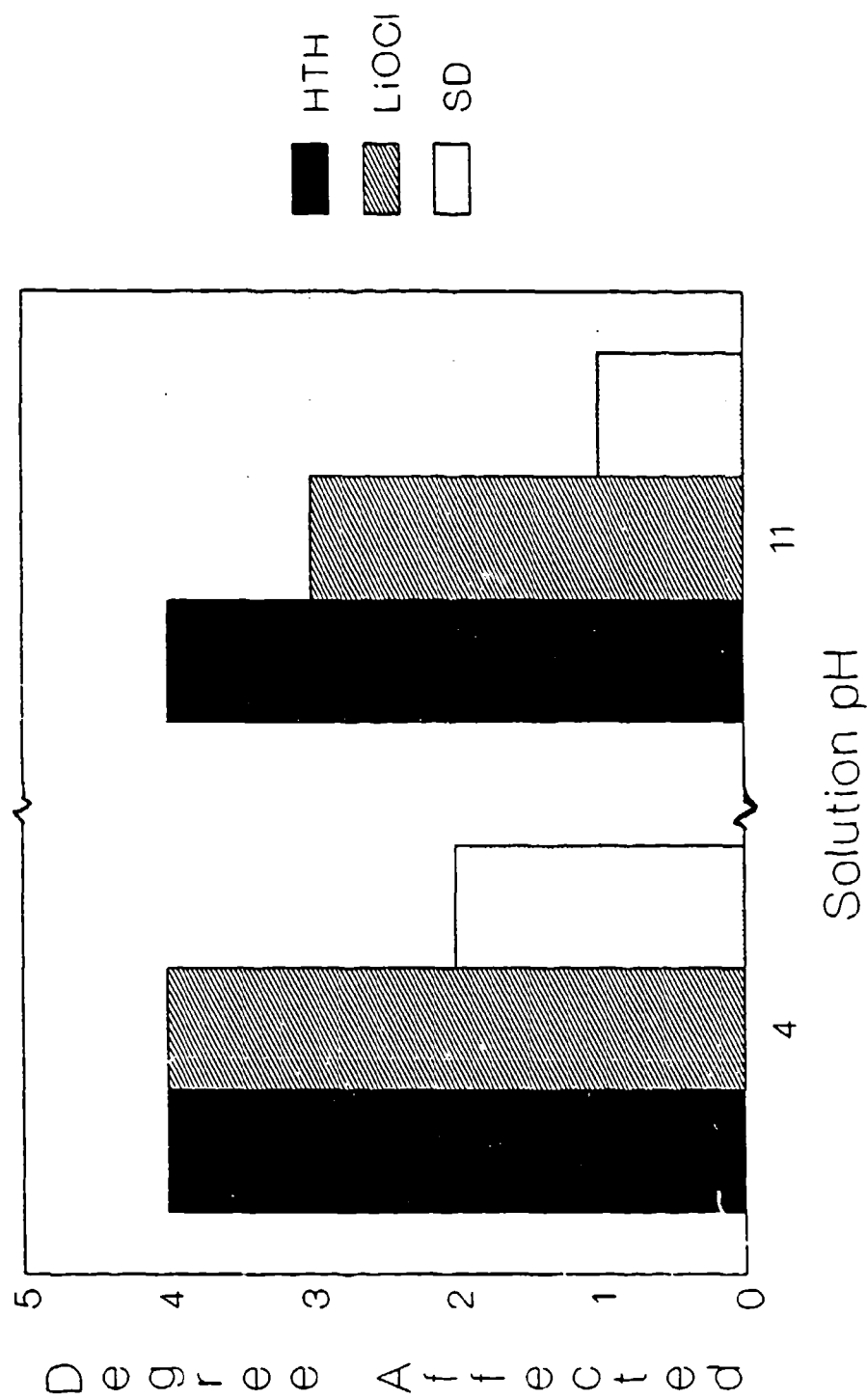


FIGURE 2: EFFECT OF OXIDANT ON NON-SKID
VISUAL INSPECTION

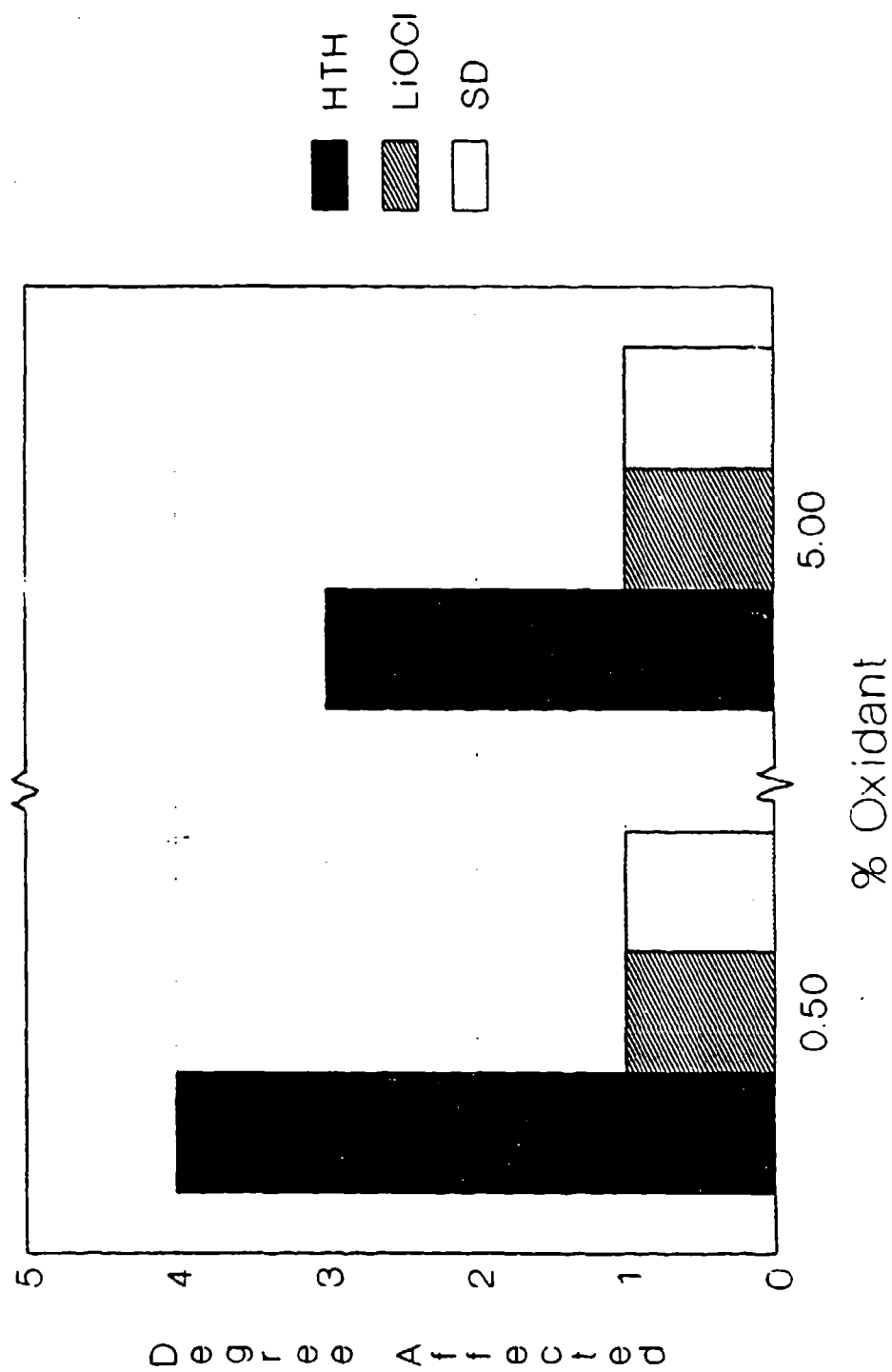


FIGURE 3: EFFECT OF TIME ON NON-SKID
VISUAL INSPECTION

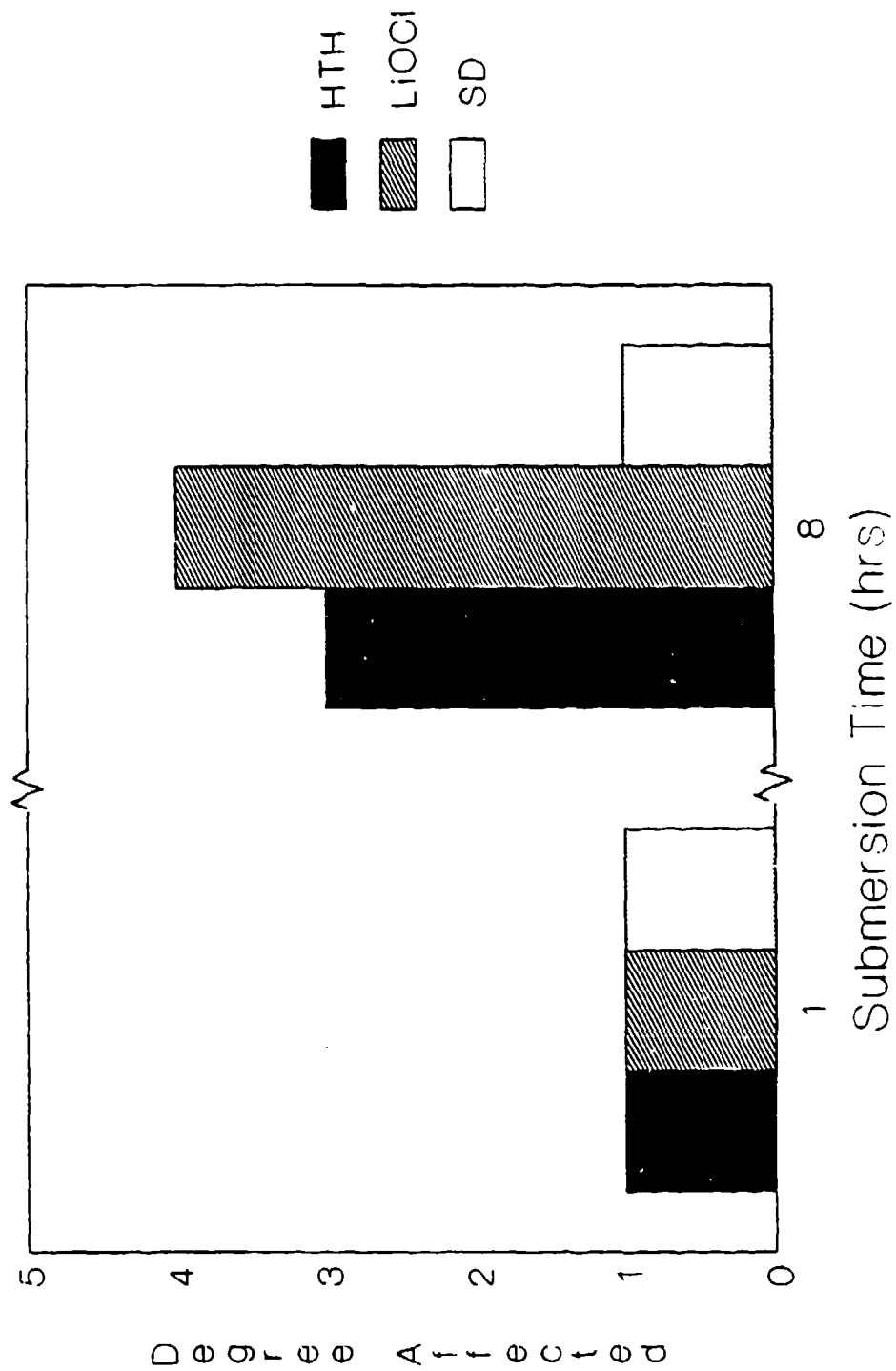


FIGURE 4: EFFECT OF pH ON ALKYD
VISUAL INSPECTION

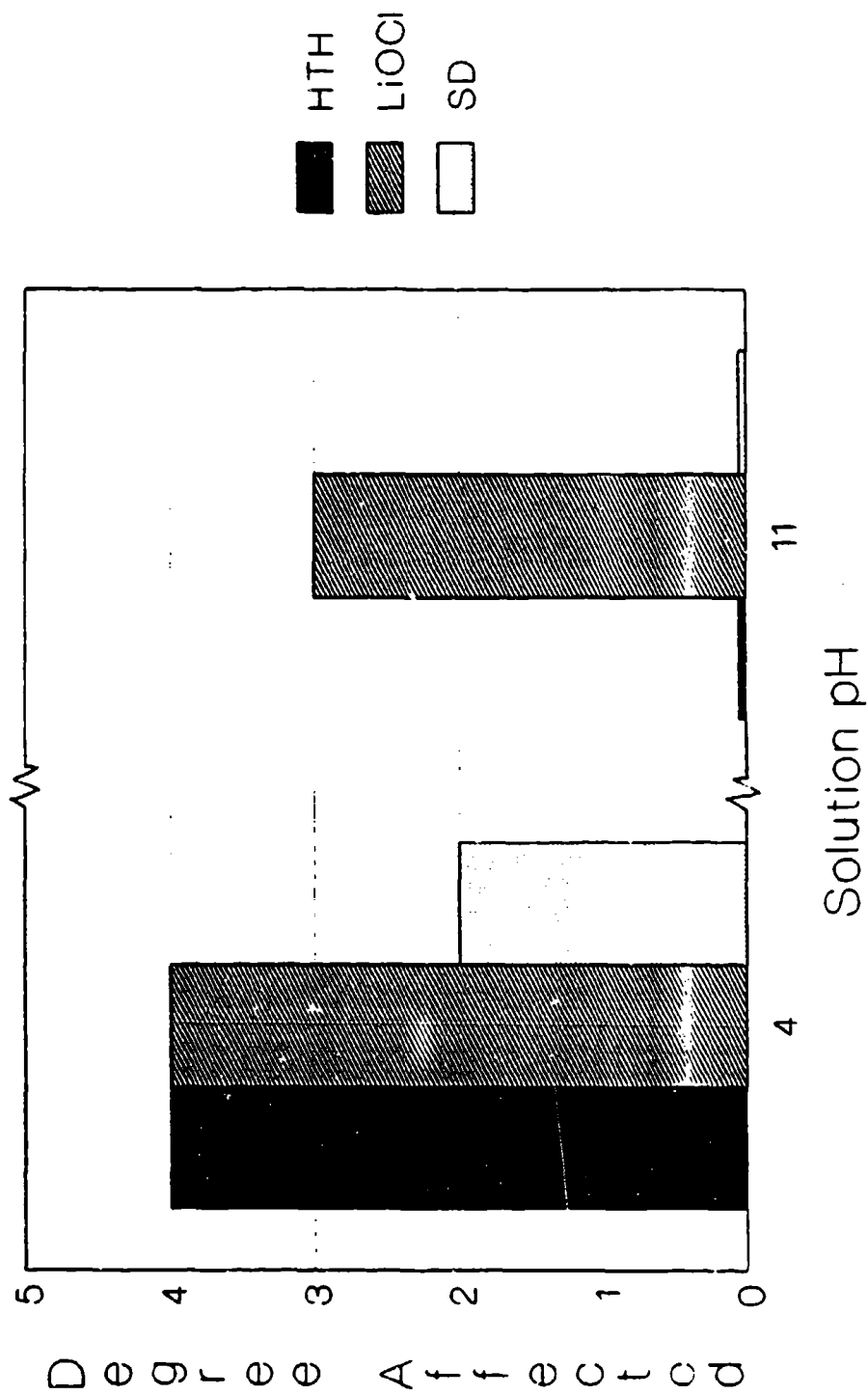
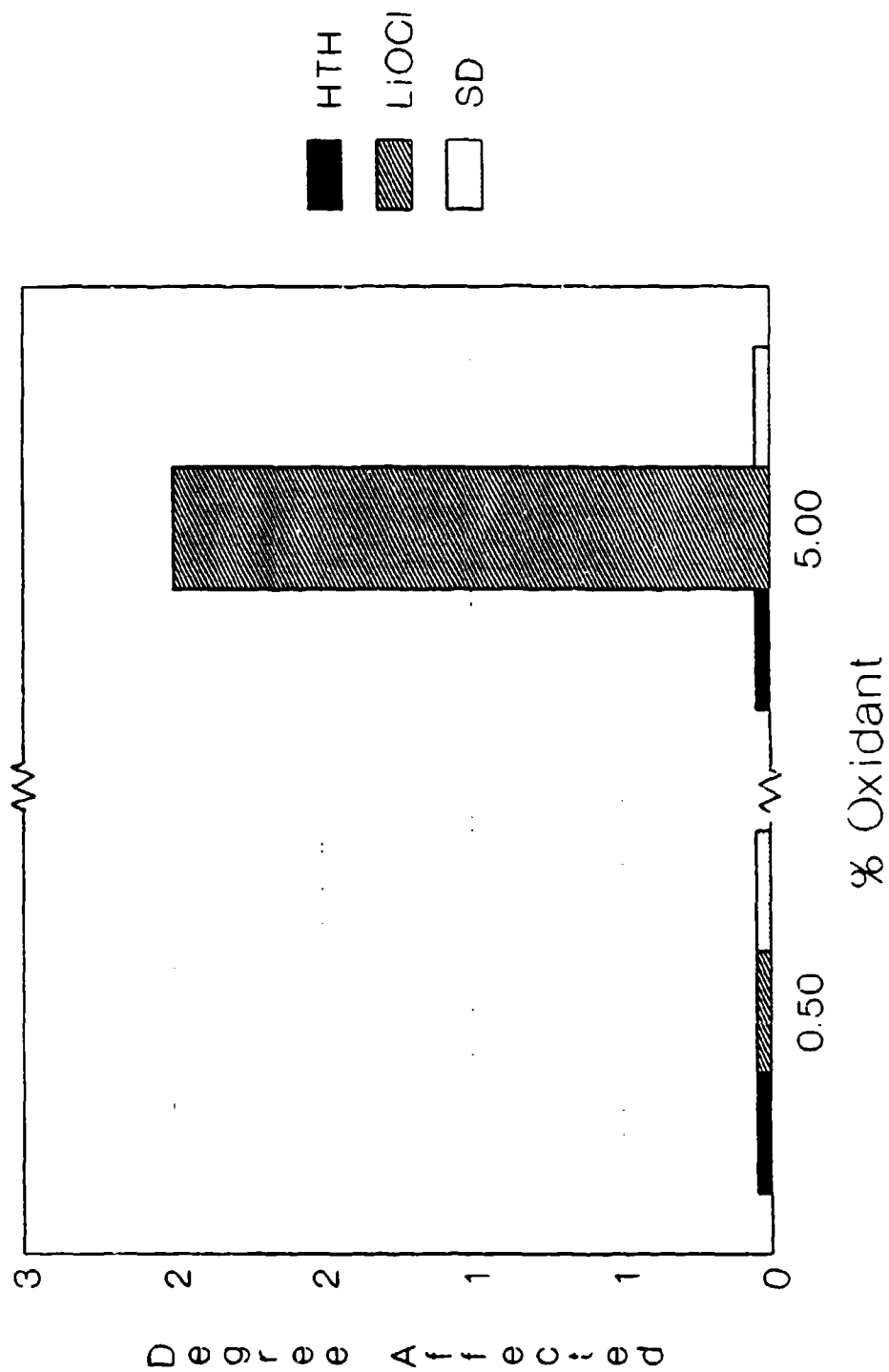


FIGURE 5: EFFECT OF % OXIDANT ON ALKYD
VISUAL INSPECTION



**FIGURE 6: EFFECT OF TIME ON ALKYD
VISUAL INSPECTION**

